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Forest Health Protection

Northeastern California Shared Service Area

2550 Riverside Drive, Susanville, CA 96130

Special Project Report

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To: District Ranger, Beckwourth Ranger District, Plumas National Forest

Subject: Wheeler Fire – Post-fire bark and woodboring beetle activity (NE-SPR-13-01)

Thank you for allowing Forest Health Protection (FHP) to monitor fire-injured trees in the 2007 Wheeler Fire and uninjured trees adjacent to the fire perimeter. As of 2011, we completed the three-year monitoring of 285 conifers within 18 plots located southeast of Antelope Lake (T26/27N, R13E). The Wheeler Fire provided an opportunity to observe post-fire bark and woodboring beetle activity and associated tree mortality within and adjacent to burned stands.

Summary of Results

Monitoring fire-injured and adjacent uninjured conifers revealed similar patterns of bark and woodboring beetle activity and tree mortality as observed in other fires in the Sierra Nevada and Cascade Mountain Ranges. First, the highest percentage of mortality occurred in trees that sustained high levels of crown kill. For monitored trees within the burn, the average crown length killed was 58% for dead trees and 19% for live trees. Second, most of the mortality (93%) occurred by the end of the second post-fire year (Table 1). This is consistent with other FHP monitoring that shows that approximately 80% of post-fire mortality occurs by year two. Third, woodboring beetle and red turpentine beetle activity was higher in burned stands (Table 1). And finally, it doesn't appear that bark beetle activity built up within the burned area and moved into adjacent unburned stands. However, the Wheeler Fire and surrounding areas experienced moderate drought conditions from 2006 through 2009 leading to elevated and widespread bark beetle-caused mortality which continued through 2011. This drought related bark beetle activity across the region overrode any effects that the fire may have had on bark beetle activity and tree mortality in adjacent areas.

Bark beetle activity (excluding red turpentine beetle) was limited within all plots, burned or unburned. Fir engraver beetle (*Scolytus ventralis*), observed in eight dead white fir, was the only bark beetle observed in unburned plots. Jeffrey pine beetle (*Dendroctonus jeffreyi*) was the only bark beetle observed within the burn plots, causing the mortality of one Jeffrey pine. Most of the monitored trees within the burn received limited crown injury which may explain the apparent lack of post-fire bark beetle activity in these plots.

Data Collection

Eighteen randomly distributed variable radius plots were established in both burned and adjacent unburned areas in 2009. Burned plots were established in low to moderate fire severity areas as high severity areas had few live trees to monitor. Unburned plots were located within two miles of the Wheeler Fire perimeter. All plots were established in stands identified as eastside pine type.

Plot centers were established 25 feet due north of a tagged bearing tree. Bearing tree locations were recorded with a GPS unit. A 5 or 10 factor angle gauge was used to identify monitoring trees within each plot. Each tree was identified as live or dead and assessed for percent crown length killed to the nearest 5 percent. All observable bark and/or woodboring beetle activity was recorded. Tree status (live or dead) and beetle activity was collected on the same trees in 2010 and 2011. Trees with 0 – 35 percent crown length killed (PCLK) were considered to have light fire-injury, 40 – 65 PCLK were considered moderate and 70 – 100 PCLK were considered severe. Cambium was not sampled for this project.

Summary of data collected from the 2007 Wheeler Fire

Burned plots averaged 79 sq.ft./acre of basal area while unburned plots averaged 187 sq.ft./acre. Most of the randomly located plots in the burned area fell within previously thinned defensive fuel profile zones (DFPZ) while all but one of the unburned plots were located within unthinned stands. DFPZ units were basically the only sites within this portion of the burned area that had significant tree survival.

Monitored trees within the burn consisted of 65 Jeffrey pine, 49 ponderosa pine, 4 white fir and one Douglas-fir. Average diameter breast height (dbh) was 17.7” (range 3.0” to 37.9”). Trees outside of the burn consisted of 64 Jeffrey pine, 60 ponderosa pine, 28 white fir, 11 lodgepole pine, two incense cedar and one sugar pine. Average dbh was 16.7” (range 1.5” to 45.3”).

Table 1. Number of trees, fire-injury severity, mortality by year and beetle activity.

		Fire-injury severity (# of trees/# that died)			Mortality by year (# of trees)			Beetle Activity	
Area	# of Trees	Light	Moderate	Severe	2007-2009	2010	2011	Trees w/ woodboring beetles	Trees w/bark beetles
Burned	119	88/5	21/2	10/7	13	1	0	31	18*
Unburned	166	0	0	0	10	0	0	12	10**

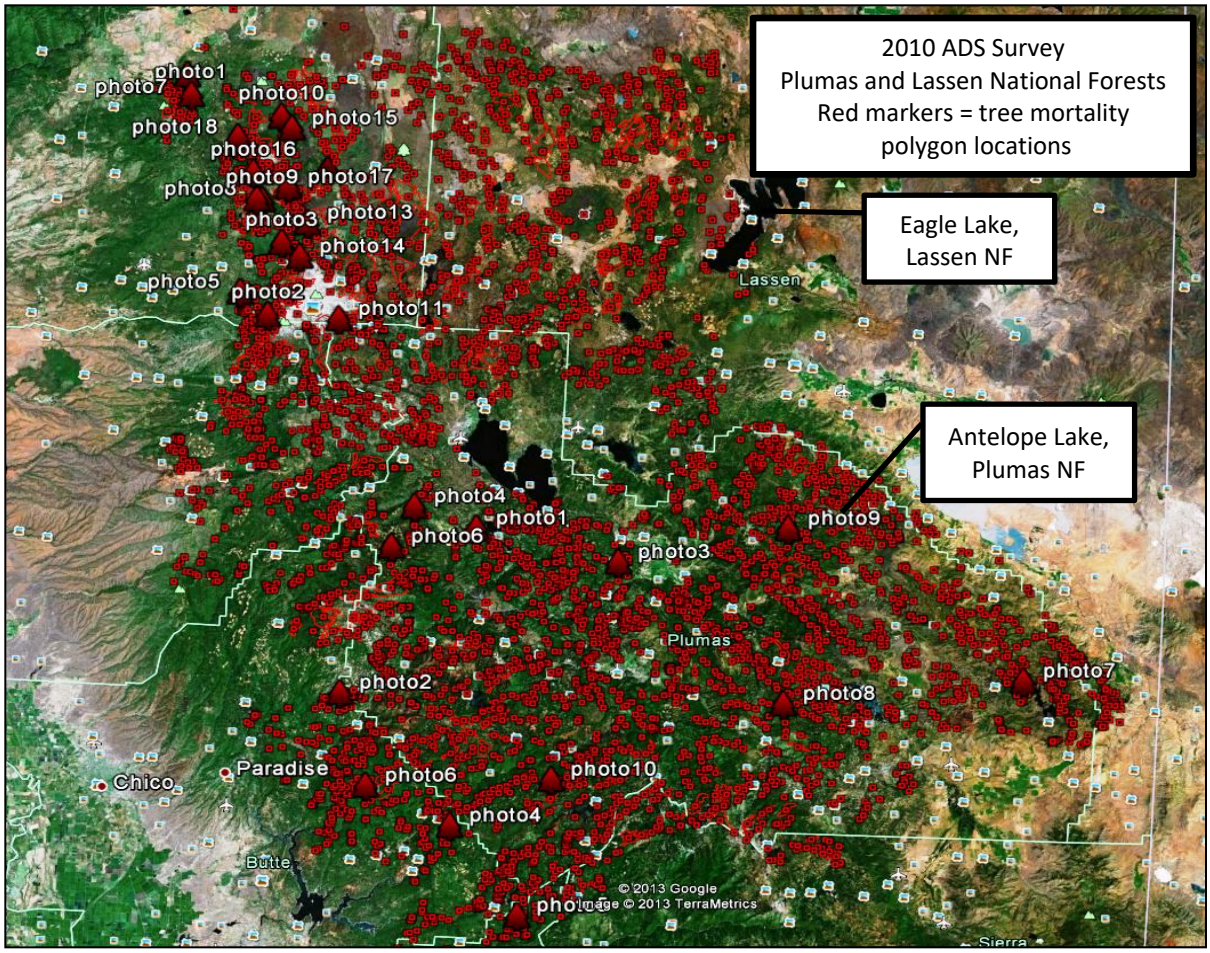
*16/18 trees only had red turpentine beetle (RTB) attacks; only 6 of the RTB attacked trees died
**8/10 trees had fir engraver beetle attacks; all fir engraver beetle attacked trees died

Discussion and Conclusion

The level of post-fire beetle activity and associated tree mortality depends on many factors such as the timing of the fire (spring/fall), the level of beetle activity in the area prior to the fire, stand characteristics (age/density/species composition) and precipitation (% of normal pre- and post-fire). Bark beetle activity within a 10 mile radius of Antelope Lake, as mapped by the FHP aerial detection survey (ADS), was very low in 2006 with the exception of tree mortality within the Boulder Complex Fire. In 2007, only three small areas (<100 acres total) outside of the Wheeler and Boulder Complex Fire perimeters were mapped with scattered ponderosa pine or white fir mortality. In 2008, about 150 acres were mapped outside of the Moonlight, Wheeler and Boulder Complex Fires with ~1 tree per acre killed by bark beetles. Tree mortality was high within the Moonlight and Wheeler fires this same year due to various combinations of fire-injury and bark and woodboring beetle activity. Bark beetle activity increased significantly in 2009 and remained elevated through 2011 both within and outside of burned areas.

It is difficult to directly relate the mapped mortality from 2009 to 2011 in unburned areas to any bark beetle activity that occurred within the three fire areas. This is because the same elevated levels of bark beetle-caused tree mortality were also mapped throughout the rest of northeastern California over the same time period. For example, Map 1 shows a similar number and distribution of mapped mortality polygons for the Plumas and Lassen National Forests in 2010.

Map 1. 2010 ADS Survey for Lassen and Plumas National Forests



The widespread tree mortality mapped by the ADS was more associated with below normal precipitation (and high stand density in some areas) rather than proximity to recently burned stands. Northern California precipitation for the water years (Oct-Sept) of 2006-2007, 2007-2008 and 2008-2009 were 63%, 72% and 76% of normal respectively. Low precipitation levels such as these have historically resulted in widespread bark beetle activity and associated tree mortality in northeastern California.

The level of fire-injury on an individual tree also plays a role in post-fire beetle activity. Fire damaged trees can be placed into three categories: 1) those killed outright or so severely injured by the fire that they will soon die, 2) those that are uninjured or lightly injured and should survive, and 3) those in between, the moderately injured trees. Bark beetles will attack trees in all three categories but successful brood production will only occur in trees with moist cambium. Trees in category one typically do not have enough moist cambium after the fire or if they do, it will become either resin soaked or dry out before beetles can complete their development. Furthermore, trees that are mostly consumed during the fire are less likely to be attacked by bark beetles. Trees in category two provide the highest level of suitable cambium for bark beetles but typically are not injured to the extent that their defenses are compromised. These trees still have the ability to pitch out beetles as they attack, or more often, are avoided by bark beetles altogether (low level fire-injury can sometimes increase a pine's resin defenses). The highest level of bark beetle attacks are likely to occur on trees in category three, the moderately injured trees. These trees will have moderate to high levels of crown scorch and cambium injury that compromise their defense systems and put them at a higher probability of mortality based on fire-injury alone. These trees can provide ideal habitat for bark beetles, especially if cambium injuries are concentrated on the lower bole or at the root collar. Fires with high numbers of moderately fire-injured trees have the potential to build up large numbers of bark beetles that will continue to attack and kill trees within the fire perimeter over several years. Woodboring beetles are likely to attack and successfully reproduce in both moderate and severely injured trees but since these types of beetles typically attack only dead and dying trees, they are not a threat to healthy trees within or adjacent to the burned areas.

Past FHP observations of post-fire beetle activity reveal that bark beetles continue to attack fire-injured trees for about 5 years with most activity occurring in the first 2 - 3 years. Unburned trees within and adjacent to the fire perimeter are seldom attacked or are unsuccessfully attacked. When successful attacks on uninjured trees have been observed, most mortality has been restricted to individuals and small stands that were directly adjacent to groups of fire-injured trees with high levels of bark beetle activity. These uninjured stands were also generally in an unhealthy condition due to overstocking and drought and therefore highly susceptible to successful bark beetle attacks. A couple of recent local examples of this are the western pine beetle-caused mortality of uninjured ponderosa pines that were growing along the edge of the 2008 Sugarloaf Fire perimeter near Old Station, CA (Lassen National Forest) and an ~15 acre ponderosa pine stand growing on the western edge of the Moonlight Fire north of Taylorsville, CA (Plumas National Forest) (Figure 1). Both stands were adjacent to an area with many moderate to severely burned ponderosa pines with high levels of western pine beetle activity. The latter stand was extremely dense (stocked at >240 sq.ft./acre with average dbh of 16") and would have been considered to be at a very high risk for western pine beetle-caused mortality

regardless of its proximity to the Moonlight Fire. Western pine beetle activity has not spread beyond these attacked stands in subsequent years.

The Wheeler Fire experienced high burn severity on approximately 60% of the acres. These areas had very few living trees immediately post-fire that would have provided suitable bark beetle habitat. Approximately 20% burned at low severity leaving mostly trees that were only lightly injured and not highly susceptible to bark beetle attacks. This leaves ~20% of the fire area that may have contained high numbers of moderately fire-injured trees and many were likely attacked by bark beetles from 2007 to 2011; increasing bark beetle populations. However, based on our plots, it doesn't appear that the Wheeler Fire experience significant bark beetle activity in lightly burned areas or created additional mortality in nearby unburned stands. During the first two post-fire years, drought conditions resulted in elevated levels of bark beetle-caused tree mortality across the region, likely overriding any effects from the wildfire. It also made it difficult to assess any impacts of the Wheeler Fire on adjacent unburned stands.

Figure 1. Western pine beetle-caused mortality of ponderosa pine adjacent to 2007 Moonlight Fire.

Data from this monitoring project serves only to document the post-fire bark and woodboring beetle activity that occurred as a result of the Wheeler Fire in eastside pine. This data may be referenced for future post-fire management discussions in this and similar forested stands in surrounding areas.

FHP greatly appreciates the cooperation of District personnel in providing areas for this monitoring project and looks forward to working with you again as opportunities arise. Please contact me if you have any questions.

/s/ Danny Cluck

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cc: Region 5 Forest Health Protection, Regional Office